



*An Econometric study on the Impact of Demographic Indicators
on the Financial Balance of the National Retirement Fund
(NRF) in Algeria*

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Abstract

This article evaluates the effect of demographic factors on the financial balance of the National Retirement Fund (NRF) using the Autoregressive Distributed Lag (ARDL) approach combined with stability tests. Using this approach, we reach the conclusion that the influence of demographic factors is a long-term phenomenon. The bounds testing procedure also reveals that the cointegration relationship is stable throughout the study period. This result was confirmed by combining the CUSUM and CUSUMSQ residual tests. The obtained results also show that life expectancy, mortality rate, and net migration balance contribute to the deficit of the National Retirement Fund.

✓ **Keyword.** Demographic factors. NRF. ARDL. Financial balance.

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1. INTRODUCTION

In all countries around the world, the retirement system plays a significant role in society by providing retirees with a range of services that meet their needs in various ways. It aims to protect individuals from events that occur throughout their lives, covering hospitalization expenses, medication costs, and pension payments, while also addressing expenses related to occupational illnesses. It also provides various benefits related to childbirth, education assistance, and housing support.

In Algeria, the retirement system implemented on 1 January 1984 is considered one of the most effective in the world and a genuine social achievement for Algerian workers. This retirement system operates on a pay-as-you-go basis (MENDIL D., CLAIRE E-M., and HAMMOUDA N., 2018), with contributions and defined benefits. It consists of two regimes: one for self-employed individuals, managed by the National Fund for Self-Employed (Casnos), and the other for employees, managed by the National Retirement Fund (NRF).

The NRF plays a crucial role in providing retirement benefits to workers in the public sector. However, the CNR faces financial challenges associated with several factors, particularly demographic variables. These demographic factors, such as population aging (SAHRAOUI. S, 2012), changes in the structure of the active population, life expectancy, and birth rates, have a significant impact on the financial viability of the NRF.

Thorough analysis and appropriate measures are necessary to ensure the sustainability and longevity of the retirement system in the country. In light of the demographic transition resulting from the improvement in the standard of living for Algerians, we aim to demonstrate the impact of demographic indicators on the income and expenses of the National Retirement Fund (Hammouda N- E, Merouani W., 2015).

This article aims to address the following research question: **What is the impact of variations in the demographic environment on the financial situation of the NRF?** The purpose of this article is to analyze the relationship between demographic variables and the financial balance of the National Retirement Fund, examining the contribution of each variable to this balance in Algeria using the ARDL model approach. To address this question, two hypotheses will be tested:

- Demographic factors affect the long-term financial balance of the National Retirement Fund.

2. Literature Review

Econometric studies play a vital role in quantifying the relationship between demographic variables and the financial equilibrium of the NRF. These studies employ econometric models and statistical data to analyze the impact of demographic indicators on the solvency, sustainability, and viability of retirement systems.

A considerable body of research focuses on specific countries, while others adopt a comparative approach, examining multiple nations. Key demographic variables considered in these studies include population aging, the demographic dependency ratio, fertility rates, life expectancy, and other factors related to the age structure of the population.

Findings from these studies exhibit variation due to differences in methodology, national contexts, and specific characteristics of the retirement systems being studied. Notably, some research highlights that significant demographic changes, such as population aging, can exert financial pressure on retirement systems. Conversely, other studies emphasize the importance of combining demographic factors with appropriate retirement policies to ensure financial viability.

In an empirical study by MARCEAU (2013), a long-term relationship was

identified between indicators of balance in the pay-as-you-go retirement system and economic-demographic variables. Similarly, HAFFAR and DIB (2018) employed econometric modeling in their study, which demonstrated the influence of economic and demographic variables on the performance of the retirement system in the medium and long term. Examining the impact of population aging on retirement expenses in Algeria, BOUGARNE and ALLAM (2019) observed that declining fertility rates, decreasing mortality rates, and improved life expectancy have led to an inverted age pyramid and a decrease in the dependency ratio. This demographic shift, combined with the factor of unemployment, has had direct consequences on retirement financing.

3. Overview of the Algerian Retirement System:

In this section, we will provide a comprehensive overview of the historical development and current status of the national retirement system in Algeria.

3.1 Historical Development of the Algerian National Retirement System

The Algerian national retirement system has undergone significant transformations throughout its history. Prior to the country's independence in 1962, there was no unified and organized retirement system operating at the national level. Various categories of workers were subject to fragmented and specific retirement schemes, characterized by limited coverage and benefits.

The establishment of the National Retirement Fund in 1965 (the Social Fund of the Alger and Oran region, 1963) marked a turning point in Algeria's retirement landscape. The primary objective of the NRF was to centralize the existing retirement schemes, streamline administrative processes, and ensure effective management of retirement funds. By collecting contributions and disbursing retirement benefits to eligible recipients, the NRF aimed to provide a more cohesive and encompassing retirement framework.

In the 1970 (The Organization and Administration of Social Security, 1973), the Algerian government initiated comprehensive reforms to unify the retirement schemes and standardize contribution and benefit regulations. These reforms sought to foster greater fairness and extend retirement coverage to a broader spectrum of the workforce. By harmonizing the rules governing retirement provisions, the government aimed to establish a more equitable system that catered to the diverse needs of workers.

Since then, the Algerian retirement system has continued to evolve in response to shifting demographics, economic dynamics, and social exigencies. Specific reforms have been implemented to enhance the system's financial sustainability and ensure adequate benefits for various categories of workers (SALHI T., 2016). These reforms have been designed to address the challenges posed by demographic changes, such as population aging and shifting labor dynamics.

More recently, the Algerian government has undertaken further reforms to safeguard the long-term financial viability of the retirement system. These measures have encompassed adjustments to retirement ages, revisions of benefit calculation methodologies, and targeted initiatives to promote the employment of older workers. By aligning retirement policies with emerging demographic trends and economic imperatives, the government seeks to ensure the system's adaptability and resilience in the face of evolving labor market dynamics.

It is worth noting that the Algerian retirement system remains dynamic, continuously adapting to accommodate the changing needs of workers and respond to the country's evolving demographic and economic landscape. These ongoing developments reflect a commitment to create a robust and sustainable retirement framework capable of meeting the diverse retirement requirements of Algerian workers.

3.2 Current Retirement System

The current Algerian retirement system encompasses various retirement schemes designed to provide benefits to workers and retirees. Contributions are deducted from workers' salaries or income, and retirement benefits are calculated based on the duration of contributions and the reference salary or income. This section outlines the key components of the retirement system in Algeria, including the types of retirement schemes and the administrative authority responsible for managing the system.

Table 1. Types of Retirement Schemes offered by the current retirement system

Scheme Worker	Categories General Retirement
Scheme Applicable to public sector workers,	including civil servants, employees of state-owned enterprises, and local government employees.
Self-Employed Scheme	Applicable to self-employed workers, such as traders, craftsmen, and professionals.
Private Sector Workers Scheme	Applicable to workers in the private sector.
Agricultural Workers Scheme	Applicable to workers in the agricultural sector.

Source: Compiled by the author.

The division of the retirement system into distinct schemes reflects the diverse nature of the workforce in Algeria and aims to accommodate the specific needs and characteristics of different worker categories. This approach recognizes the unique requirements and circumstances of workers across various sectors and occupations, thereby contributing to the overall fairness and effectiveness of the retirement system.

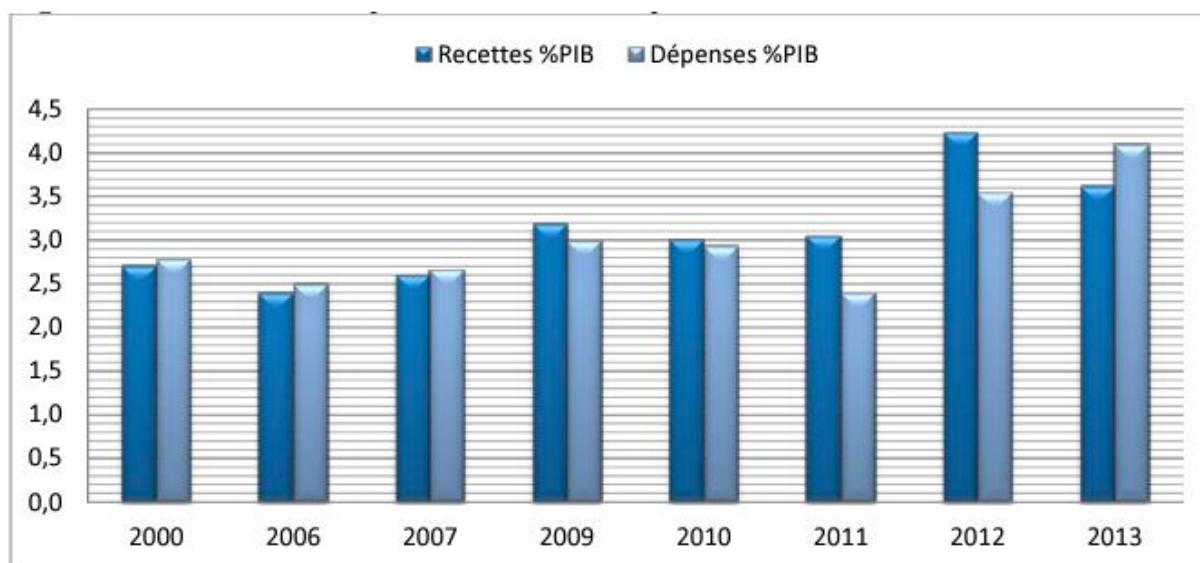
4. Financial Situation of the CNR and Funding Mechanisms:

In this section, we will present an analysis of the financial situation of the retirement system in Algeria, focusing on the NRF, and discuss the various funding mechanisms utilized.

4.1. Financial Situation of the National Retirement Fund:

Between the years 2000 and 2013, there was a significant increase in revenues within the Algerian retirement system, with figures rising from 111 billion dinars, equivalent to 2.8% of the Gross Domestic Product (GDP), to 598.9 billion dinars in 2013, representing 4.1% of the GDP. During this period, retirement-related expenditures also experienced a consistent upward trend. Consequently, the share of retirement expenses as a percentage of the GDP witnessed a substantial rise, climbing from 2.8 percentage points in 2000 to 4.4 percentage points in 2013.

The years 2006 and 2007 were notable for a financial imbalance encountered by the the national retirement fund. However, through an adjustment in the retirement contribution rates from 16% to 17.25%, the system was able to regain equilibrium. Recognizing the need to ensure the long-term financial viability of the retirement system, the public authorities implemented essential measures, including the establishment of the Fonds National de Réserves des Retraites (FNRR), the National Retirement Reserves Fund, in 2007. This fund primarily relied on the allocation of 2%, subsequently increased to 3%, of the petroleum tax revenues. Its creation, authorized by presidential decree, aimed to build a substantial financial reserve capable of addressing future challenges associated with rising retirement expenses, particularly due to demographic aging.

Fig.1. Evolution of Retirement Revenues and Expenditures as a Share of the GDP

Source: CNES website, DGPP/MF

4.2. Financing of the CNR

The financing model of the retirement system is intrinsically linked to its occupational nature. The primary sources of funding stem from the contributions made by employers and employees, supplemented by the involvement of the state budget (AE, 2020).

a. Financing from contributors:

The financing of the fund relies on contributions from both employers and employees. The total contribution rate amounts to 34.5% of the salary subject to contribution. This rate is allocated among different branches of the social security system as outlined in the following table:

Table 1. Distribution of contribution rates by branch

Branch	Employer's responsibility	Employee's responsibility	Fund for Social Welfare	Total
Social insurance	12.5%	1.5%	-	14%
Work accidents and occupational diseases	1.25%	-	-	1.25%
Retirement	10%	6.75%	0.5%	17.25%
Unemployment insurance	1%	0.5%	-	1.5%
Early retirement	0.25%	0.25%	-	0.5%
Total	25%	9%	0.5%	34.5%

Source: Compiled by the author based on available data from the CNR.

The funding structure of the NRF relies on contributions from both employers and employees, which are allocated among various branches of the social security system. The specific contribution rates for each branch are as follows:

- Social Insurance Branch: Employers contribute 12.5% of the salary subject to contribution, while employees contribute 1.5%. No contributions are made from the Fund for Social Welfare in this branch. The total contribution rate for this branch amounts to 14%.
- Work Accidents and Occupational Diseases Branch: Employers contribute 1.25% of the salary subject to contribution. There are no contributions from employees or the Fund for Social Welfare in this branch. The total contribution rate for this branch is 1.25%.
- Retirement Branch: Employers contribute 10% of the salary subject to contribution, while employees contribute 6.75%. The Fund for Social Welfare contributes 0.5%. Therefore, the total contribution rate for this branch is 17.25%.
- Unemployment Insurance Branch: Employers contribute 1% of the salary subject to contribution, while employees contribute 0.5%. No contributions are

made from the Fund for Social Welfare in this branch. The total contribution rate for this branch amounts to 1.5%.

- Early Retirement Branch: Both employers and employees contribute equally, with a rate of 0.25% of the salary subject to contribution. There are no contributions from the Fund for Social Welfare in this branch. The total contribution rate for this branch is 0.5%.

To summarize, the financial sustainability of the NRF is ensured through the collection of contributions from employers and employees, which are distributed among the aforementioned branches of the social security system according to the specified rates.

b. State Funding

The Algerian government provides subsidies to the NRF to support its functioning and ensure the payment of retirement benefits. These subsidies serve to cover financial deficits within the fund and finance various social protection programs. Notably, the state funding includes differential supplements and complementary allowances, consisting of three components: CARDP (complementary allowances for retirement and disability pensions), CARB (complementary allowances for retirement benefits), and CAPA (complementary allowances for pensions and annuities). Additionally, family allowances and other expenses are covered under state funding.

Moreover, in 2006, the Algerian authorities established the National Reserve Fund for Retirements, financed at a rate of 2% of petroleum tax revenues. Subsequently, the government decided to increase the rate to 3% of petroleum tax revenues starting from 2012 (Demography and the Algerian retirement system, 2012).

It is worth noting that the financing of the National Retirement Fund in Algeria is subject to potential revisions and adjustments in response to legislative, economic,

and demographic changes. The Algerian government plays a crucial role in the management and oversight of the retirement system, ensuring the long-term financial sustainability of the NRF and the timely disbursement of retirement benefits to eligible recipients.

5. The economic challenges and issues facing the retirement system in Algeria

The system operates on a pay-as-you-go basis, where the retirement pensions are funded by the contributions of active workers. However, the imbalance between the amount of contributions and the amount of pensions creates financial strains on the retirement and social security funds. Reforms have been implemented to restore balance and align the various retirement systems.

The Algerian government has made choices regarding retirement systems, favoring a distribution-based model over a capitalization-based one. This implies that future pensions may not necessarily be equivalent to current ones and that distribution rules could be modified based on demographic changes. The increasing number of retirees in the population (the number of retirees increased from 2 million in 2010 to over 3.3 million by the end of 2022, with an annual growth of approximately 130,000 retirees each year) (NRF, 2022) impacts the economic equilibrium and the financing of the retirement system.

The funding of the social security funds and the National Retirement Fund relies on state reserves. These measures are taken to improve retirees' standard of living, stimulate consumption, and promote savings while preserving the distribution and intergenerational solidarity system.

In the coming decades, the Algerian retirement system will face accelerated demographic aging (with an average annual rate of 3.1% among individuals aged 65 and above, evolving faster than the rest of the population (2.5%)) due to declining fertility rates (the fertility rate decreased from 3 to 2.9 children between 2019 and

2020) and increased life expectancy (rising from 66.9 years in 1990 to 77.1 years in 2015) (ONS, 2022). These factors present significant challenges in ensuring the sustainability of the retirement system.

6. Data and Estimation Methodology

6.1 Data: Source and Description

The data for this study, specifically the demographic indicators, were sourced from various institutions, including the National Office of Statistics, the World Bank, and the statistics provided by the National Pension Fund. These data consist of annual series spanning the period 1990-2020, resulting in a total of 30 observations. A brief description of all the variables used in the study is presented in the table below.

Table 3. Description and Units of Measurement of Variables Included in the Model.

Variable	Label	Definition
RE	Balance Ratio	Ratio of income to expenses. This ratio provides a precise description of the fund's surplus or deficit.
TBM	Gross Mortality Rate	Ratio of the number of deaths to the average total population in the same year.
TDD	Demographic Dependency Ratio	Ratio of the number of individuals over 60 years old to the population aged 20 to 59.
EV60	Life Expectancy at Age 60	Average number of years remaining beyond the age of 60 based on age-specific mortality rates for the year.
NM	Net Immigration	Difference between the number of immigrants entering a region and the number of immigrants leaving the same region throughout the year. Source: Compiled by the author.

Source: Created by myself

Our raw series are transformed into logarithmic series to attenuate variance. The logarithms of the series are denoted as LRE (using the ratio), LTBM, LTDD, LEV60,

and LNM (using absolute value). Consequently, we can proceed with the stochastic analysis of our series and interpret the results that we will identify.

6.2 Estimation Methodology of the Model

Spurious regression refers to a situation where the use of non-stationary time series in a linear regression produces misleading, overly optimistic results that suggest a relationship between variables when there is none (Granger-Newbold, 1974). To overcome this issue, several techniques can be employed to test the existence of a long-term equilibrium relationship - cointegration - among the variables in time series data. In this study, a relatively new technique developed by Pesaran (1997), Pesaran and Smith (1998), Pesaran and Shin (1999), and Pesaran et al. (2001) was used. This methodology is known as the Autoregressive Distributed Lag (ARDL) approach, which performs well with small samples and has the advantage of not requiring all variables to be integrated at the same order. It remains applicable even when we have both $I(0)$ and $I(1)$ variables in the set. Moreover, this technique allows for the simultaneous consideration of long-term dynamics and short-term adjustments using the bounds testing approach. In this context, we apply this approach to examine the impact of demographic factors on the financial situation of the National Pension Fund. The general form of the ARDL model used is as follows:

$$\Delta Y_t = \beta_0 + \underbrace{\left\{ \sum_{i=1}^n \beta_i \Delta y_{t-i} + \sum_{i=0}^n \delta_i \Delta x_{t-i} \right\}}_{\text{Court - terme}} + \underbrace{\left\{ \varphi_1 y_{t-1} + \varphi_2 x_{t-1} \right\}}_{\text{Long - terme}} + \mu_t \dots \dots (1)$$

Where:

Δ is the first difference operator. β_i, δ_i are the short-term coefficients.

ϕ_1, ϕ_2 are the long-term coefficients of the ARDL model. μ_t is the error term;

In our study framework, the estimated ARDL model is expressed as follows:

$$\begin{aligned} \Delta LRE_t = & \beta_0 + \sum_{i=1}^p \beta_1 \Delta LRE_{t-i} + \sum_{i=0}^{q_1} \delta_1 \Delta LTBM_{t-i} + \sum_{i=0}^{q_2} \delta_2 \Delta LTDD_{t-i} + \sum_{i=0}^{q_s} \delta_3 \Delta LEVA60ANS_{t-i} \\ & + \sum_{i=0}^{q_4} \delta_4 \Delta LNM_{t-i} + \phi_1 LRE_{t-1} + \phi_2 LTBM_{t-1} + \phi_3 LTDD_{t-1} + \phi_4 LEVA60ANS_{t-1} \\ & + \phi_5 LNM_{t-1} + \mu_t \dots \dots \dots (2) \end{aligned}$$

We use the Schwarz information criterion (SC) to determine the optimal order selection of the ARDL model (p, q_i). Additionally, we test for heteroscedasticity, normality of residuals, and serial autocorrelation (using diagnostic tests for the estimated model).

Once the absence of residual autocorrelation is confirmed, we proceed with the bounds test. This test is, in fact, a Fisher test that jointly examines the significance of the coefficients of the K variables in levels.

$$\begin{aligned} H_0: \phi_i &= 0 \forall i = 1, 2 \dots k \\ H_1: \phi_i &\neq 0 \forall i = 1, 2 \dots k \end{aligned}$$

L'hypothèse nulle d'absence de relation d'équilibre de long terme est donnée par H_0 , contre l'hypothèse alternative H_1 de présence d'une relation uniforme de long terme entre les variables considérées. Une fois la relation de long terme est validée, nous estimons par les MCO la relation de long terme et la dynamique de court terme du modèle ARDL (p, q_1, q_2, q_3, q_4). De plus, une étape consiste à une validation du modèle estimé à l'aide des tests de stabilité de CUSUM et CUSUMQ des résidus. Enfin, un test de causalité de Granger est effectué pour examiner la direction de la causalité et la comptabilisation de l'innovation des variables de l'étude dans le futur.

6.3 Stability Test for the Study Series

Before proceeding with ARDL modeling, we conducted stability tests on the different study series. We employed the Augmented Dickey-Fuller (ADF) test (1981) and the Phillips-Perron (PP) test (1988). The table below confirms our initial observation, based on graphical analysis and correlation diagram analysis, regarding the instability of the series. The results indicate that all series are integrated of order I(0) and I(1).

Table 4. Results of the Augmented Dickey-Fuller Unit Root Test

Variable	ADF Test		PP Test		Ordre
	In Level	First Difference	In Level	First Difference	
LRE	0,0332 ⁴	-4.7674 ⁴	0,1298 ⁴	-3,9803 ⁵	I(1)
LTBM	2,9139 ⁶	-2,3451 ⁵	2,9321 ⁶	-2,3470 ⁵	I(1)
LTDD	2,0710 ⁶	-2.0855 ⁴	-3,0912 ⁵	4,1332 ⁵	I(1)
LEV60	-4,9041 ⁵	/	-4,9402 ⁵	/	I(0)
LMN	2,2904 ⁵	-5.3601 ⁶	2,3302 ⁵	-4,0620 ⁴	I(1)

Source: Created by myself using Eviews 10.

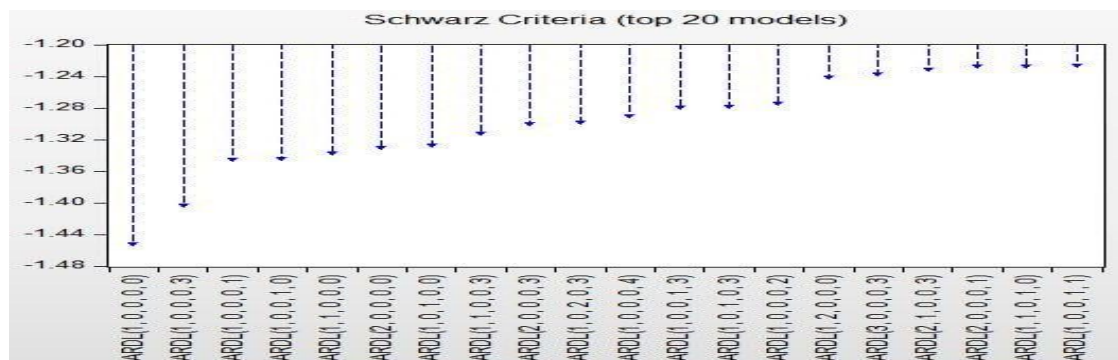
The numbers 6, 5, and 4 indicate the models that were selected: model with constant and trend, model without trend, model without constant and trend, respectively.

6.4 Determination of the Optimal Lag

Determining the optimal lag is a crucial step in choosing the optimal ARDL model that effectively explains the relationship between demographic determinants and the balance of the NRF in Algeria. To accomplish this, we used the Schwarz information criterion (SC) among other available information criteria (F-stat, AIC, and HQ). (Refer to Figure 1). This graph presents the top twenty models, and the ARDL model (1, 0, 0, 0, 0) with the smallest SC value was estimated through a

recursive search for the optimal number of lags using the Schwarz information criterion (SC).

Fig.2. Model selection graph based on the Schwarz information criterion (SC).



Source: Results provided by Eviews 10.

6.5 Cointegration "bounds test"

In this study, we employed the cointegration method introduced by Pesaran, Shin, and Smith (2001), which is based on the bounds test approach. The results of this test led us to reject the null hypothesis of non-cointegration between the variables because the Fisher statistic (7.499761) exceeds the upper bound for various alpha levels.

Table 5. presents the results of the bounds test procedure:

K	F-stat	Critical Value 1%		Critical Value 5%		Critical Value 10%	
4	7.499761***	(3.07	4.4)	(2.26	3.48)	(1.9	3.01)

Source: Created by myself using Eviews 10.

***, **, * indicate rejection of H_0 at the 1%, 5%, and 10% significance levels, respectively. () Critical values according to Pesaran et al., with the first value corresponding to the lower bound and the second value corresponding to the upper bound in the case of unrestricted without trend or constant.

6.6 Diagnostic tests of the model

In order to assess the strength of the chosen ARDL model, various diagnostic tests were conducted, including tests for autocorrelation, Heteroscedasticity, normality, and specification (Ramsey test). Based on the results reported in Table, the residuals exhibit all the desired properties.

Table 6. Results of diagnostic test

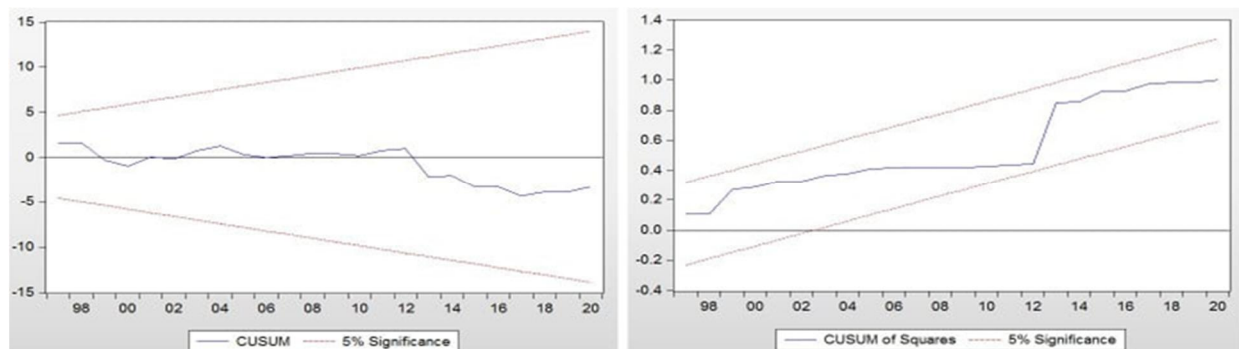
Test Statistic	F-statistic	Probability
Autocorrelation test (LM test)	0.035971**	0.9647
Heteroscedasticity test (Breusch-Pagan-Godfrey test)	0.902493**	0.4963
Normality test (Jarque-Bera)	2.988506**	0.224416
Specification test (RESET) (RESET)	0.244177**	0.6259

Source: Created by myself using Eviews 10.

6.7 Stability tests of the model

Once the ECM model determined by equation (2) was estimated, we applied the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests, proposed by Borensztein et al. (1998), to examine the long-term stability of the model parameters. The same procedure has been used by Pesaran (1997), Mohsin et al. (2002), and Solomon (2005) for stability tests.

Fig.3. CUSUM and CUSUMSQ stability tests at a 5% significance level.



Source: Results obtained from Eviews 10 software

Based on the results obtained, we observe that the CUSUM and CUSUMSQ statistics curve falls within the critical bands of the confidence interval at a 5% significance level. This means that the null hypothesis of parameter instability is rejected.

7. RESULTS AND DISCUSSION

We have successfully validated the underlying assumptions of the model, indicating that the estimated model accurately captures the econometric relationship between demographic indicators and the financial balance of NRF. In the following sections of this work, we will interpret the estimation results and provide some recommendations. The interpretation of the estimation results involves analyzing the short-term and long-term relationships, which will be done through the interpretation of elasticity's.

7.1 Long-term dynamics:

Following Pesaran, Shin, and Smith [2001], equation (2) was estimated using ordinary least squares (OLS). The long-term equilibrium relationship resulting from the estimated ARDL (1, 0, 0, 0, 0) model is illustrated in the table. The results confirm the effect of demographic variables on the financial balance of the National Pension Fund. Specifically, the long-term elasticity of net migration balance with respect to the financial balance is negative and highly significant at a significance level of 1%. A 1% increase in the net migration balance corresponds to a 1.1% gain for the National Pension Fund. Therefore, the hypothesis of a positive long-term effect of this variable on increasing the revenues of the National Pension Fund is verified (the absolute value of the net migration variable was taken into account). This result is consistent with the hypothesis that a higher number of emigrants compared to immigrants leads to a decrease in the number of contributors to the National Pension Fund.

In the long term, the elasticity of mortality, life expectancy of individuals over 60 years old, and dependency of individuals over 60 years old with growth rates are -0.89 ($p = 0.06$), -0.05 ($p = 0.48$), and -2.71 ($p = 0.02$) respectively. These results indicate that a 1% increase in mortality, life expectancy (although its coefficient is not significant at any level of alpha), and aging leads to a worsening of the budget deficit of the National Pension Fund. The hypothesis of a negative impact of these variables on the long-term financial situation has been verified. These results may be explained by the fact that any increase in life expectancy implies that retirees receive benefits for a longer duration, thereby increasing the expenses of the national retirement fund. Additionally, with an aging population, the number of individuals receiving retirement benefits rises, further adding to the financial burden on the fund.

Interpreting these results separately, an increase in the mortality rate improves the financial situation of the National Pension Fund because it reduces the capital death benefit, which is equivalent to 12 times the retirement pension. This benefit is paid once for each retiree. Additionally, the deceased retiree is not exempt from the pension system, but their pension is transferred to the beneficiaries.

Certainly, by increasing the life expectancy of retirees by 20.9 years, the National Pension Fund will have to pay retirement benefits for over 3.3 million retirees and beneficiaries for approximately 21 years.

Finally, regarding the dependency ratio of individuals over sixty years old, the obtained results show that the increasing number of retirees in the coming years has a strong negative effect on the National Pension Fund, especially since the contribution rate is currently insufficient to balance the budget of the National Pension Fund

Table 7. Estimated Long-term Relationship using the ARDL Approach

Variables	Coefficient	Standard-Error	T-Statistic [Prob]
DLMN	0.011056	0.061821	0.178832 [0.8596]
DLTBM	-0.897075	0.461463	-1.943982 [0.0637]
DLTDD	-2.712848	1.142817	-2.373825 [0.0260]
LEVA60	-0.005357	0.007476	-0.716613 [0.4805]

Source: Calculations by the authors using Eviews 10.

. 7.2 Short-Term Dynamics (ECM)

The short-term dynamics presented in Table (5) result from the error correction specification (ECM) of the ARDL model. This specification is given by the following equation:

$$ECM = DLRE - (0.0111 * DLMN + 0.8971 * DLTBM - 2.7128 * DLTDD + 0.0054 * LEVA60ANS).....(3)$$

The results of the cointegration formula show that the estimated error correction coefficient (-0.957774) belongs to the interval [-1, 0]. This confirms that all variables are combined or have a long-term relationship. It also includes a high adjustment rate for long-term equilibrium of 95.77% per year. In simpler terms, we observe that the period of deviation between the occurrence of the shock and the return to long-term equilibrium is relatively short. This result is likely due to the policy strategies implemented by the Fund to address the deficit.

The estimations also show that the coefficients of all variables are statistically significant at the 5% and/or 10% level. These findings suggest that policies aimed at attracting and integrating immigrants, as well as initiatives to extend the working life of individuals, can contribute to the financial stability of the retirement system. By investing in immigrants, who can contribute to the workforce and the fund through

their employment and contributions, and by raising the retirement age, which extends the period of active contribution and reduces the duration of benefit payments, the National Retirement Fund can experience improved financial sustainability and a more favorable balance.

8. CONCLUSION AND RECOMMANDATIONS

This experimental study has allowed us to identify the demographic indicators that affect the long-term and short-term equilibrium of the National Retirement Fund. The study results have confirmed that the relationship between demography and NRF equilibrium is a long-term phenomenon.

Based on the study findings, we propose a set of recommendations to address the financial deficit of NRF in Algeria associated with demographic variables, which revolve around:

- Revision of Retirement Eligibility Criteria: NRF can adjust the retirement eligibility criteria based on demographic changes.
- Contribution System Reforms: NRF can consider reforms to the contribution system to account for demographic changes. This may involve adjusting contribution rates based on the age structure of the population and demographic projections.
- Promotion of Youth Employment: To cope with population aging and the decline in the active workforce, NRF can collaborate with other stakeholders to promote youth employment. This may include training programs, hiring incentives, and measures to facilitate entry into the labor market.
- Retirement Savings Awareness: NRF can implement awareness initiatives to encourage individuals to build complementary retirement savings. This can

include information campaigns highlighting the importance of long-term savings and the benefits of financial planning for retirement.

- Regular Evaluation and Adjustment of Demographic Projections: It is crucial for NRF to regularly evaluate demographic projections and adjust its policies accordingly. This will enable informed decision-making regarding retirement benefits, contribution rates, and necessary reforms to maintain financial equilibrium.

By adopting these measures, NRF can effectively address the financial deficit caused by demographic variables and ensure the sustainability of its retirement system amidst demographic changes.

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